In each curve there is a tendency to monthly maxima, the tendency being least evident in the summer months.

The principal minimum in each curve is in June.

There are nine marked maxima in each curve, of which those in the months of January, February, March, April, September, October and November, are the most nearly accordant. These maxima are as follows:

A. Jan. 13. Feb. 22. Mar. 16. Apr. 13. . . . . July 7. . . . . Sept. 25. Oct. 20. Nov. 14. Dec. 14.

M. Jan. 8. Feb. 7. Mar. 9. Apr. 8. May 18. . . . . Aug. 6. Sept. 10. Oct. 20. Nov. 14. . . . .

Two of the maxima are synchronous in the two curves; three occur in the auroral ordinate which follows the meteoric ordinate; two occur in the third subsequent ordinate, one of the two being midway between a precedent and subsequent meteoric ordinate. The accordances and the discrepancies may perhaps be explained by the hypothesis of lunar perturbations.

The daily curves present a similar accordance in the number of maxima and minima, but in consequence of the frequent uncertainty whether the auroral or the meteoric should be regarded as the precedent influence, they do not seem to furnish any additional data for satisfactory conclusions.

By variously grouping the auroral observations on each side of the days that have been designated by Wolfe and Kirkwood as rich in meteoric displays, or on each side of the middle days of meteoric periods, a variety of curves may be formed, of which the three following sets of ordinates furnish examples:

Days.	—7	—6	—5	—4	—3	—2	—1	0	+1	+2	+3	+4	+5	+6	+7
α	100	99	100	102	104	106	106	104	103	105	107	103	106	101	99
β	99	99	97	97	97	99	101	101	100	101	102	102	104	104	102
γ	103	102	101	98	97	98	98	99	101	101	101	103	105	101	98

These curves indicate a connection of meteoric displays with increasing auroral displays, together with a slight subordinate tendency to auroral maxima within one day of a meteoric display.

Although the æthereal disturbance, which is manifested by the auroras, appears to follow, more often than it precedes, meteoric falls, it seems probable that both phenomena are often dependent upon lunar perturbations or other extraneous causes. In such cases, the auroras may become visible before the meteors have reached the earth's atmosphere, and been made incandescent by friction.

STELLAR AND PLANETARY CORRELATIONS.

By Prof. Pliny Earle Chase.

(*Read before the American Philosophical Society, Sept. 20, 1872.*)

Mercury's mean distance may be grouped with the mean distances of other primary planets, so as to form the two following series:*

* In each table, C denotes the logarithm of the computed value; O, the logarithm of the observed value; E, the percentage of error in the computed value; L, the limit of retardation by solar rotation and of possible solar atmosphere; M, modulus of light. The fundamental unit is the suns's radius. The origin of the co-ordinates is taken at the intersection of the axis and the directrix.

(I.)

	C.	O.	E.
	.178352		
	.467972		
	.786253		
$\frac{3}{8}$ L	.1.133195	1.135133	—.004
$\frac{8}{9}$ "	1.508798	1.509949	—.003
☿	1.913062	1.919977	—.016
⊕	2.345987	2.332155	+.032
	2.807573		
♄	3.297820	3.311651	—.032
♆	3.816728	3.809811	+.016

(II.)

	C.	O.	E.
	.115730		
	.732349		
$\frac{2}{3}\times\frac{8}{9}$ L	1.335303	1.333858	+.003
☿	1.924592	1.919997	+.011
♂	2.500216	2.513999	—.032
♃	3.062175	3.048392	+.032
♅	3.610469	3.615063	—.011

If the limiting radius of solar retardation (L =36.4, see *ante*, p. 415) be regarded as also a limit of explosive oscillation, and if radii terminating in the cardinal points of the explosive excursion ($\frac{1}{9}$, $\frac{1}{6}$, $\frac{2}{9}$, $\frac{1}{3}$, $\frac{4}{9}$, $\frac{2}{3}$, $\frac{8}{9}$) be employed for determining a parabolic series, the mean distances of Venus, Earth, and Jupiter, will be represented by succeeding abscissas of the same series, as in Table III.

(III.)

	C	O	E
	.127899		
	.291712		
	.453089		
$\frac{1}{9}$ L	.612030	.606859	+.012
$\frac{1}{6}$ "	.768535	.782950	—.034
$\frac{2}{9}$ "	.922604	.907889	+.034
$\frac{1}{3}$ "	1.074237	1.083980	—.023
$\frac{4}{9}$ "	1.223434	1.208919	+.034
$\frac{2}{3}$ "	1.370195	1.385010	—.035
$\frac{8}{9}$ "	1.514520	1.509949	+.011
	1.656409		
	1.795862		
	1.932879		
	2.067460		
♀	2.199605	2.191493	+.019
⊕	2.329314	2.332155	—.007
	2.456587		
	2.581424		
	2.703825		
	2.823790		
	2.941319		
♃	3.056412	3.048392	+.019

If the determining series be modified by substituting L for $\frac{8}{9}$ L, and employing $\frac{4}{3}$ L for the succeeding determining abscissa, Mercury's perihelion and aphelion, and the mean distances of Venus, Mars and Jupiter, will be represented by succeeding abscissas of the same series, as in table IV.

(IV.)

	C	O	E
	.047818		
	.187943		
	.330020		
	.474049		
$\frac{1}{9}$ L	.620030	.606859	+.031
$\frac{1}{6}$ "	.767963	.782950	—.035
$\frac{2}{9}$ "	.917848	.907889	+.023
$\frac{1}{3}$ "	1.069685	1.083980	—.033
$\frac{4}{9}$ "	1.223474	1.208919	+.034
$\frac{2}{3}$ "	1.379215	1.385010	—.014
1 "	1.536908	1.561101	—.057
$\frac{4}{3}$ "	1.696553	1.686040	+.025
☿$_{1}$	1.858150	1.850507	+.018
☿$_{11}$	2.021699	2.021443	+.000
♀	2.187200	2.191493	—.010
♀ ⊕*	2.354653	2.353070	+.004
♂	2.524058	2.513999	+.023
	2.695415		
	2.868724		
♃	3.043985	3.048392	—.010
☿—♆†	3.221138	3.211038	+.024

In a communication which I presented to the Society, May 16th, 1872, I indicated some simple relations between the superficial gravity and the times of rotation of the Sun, Jupiter and the Earth. If those relations are, as I believe, determined by an influent force, we may reasonably look for some analogous relations between our own and other stellar systems.

In the solar-focal parabola which passes through α Centauri and has its directrix in a linear centre of oscillation of a solar diameter, twenty-seven successive abscissas may be taken in regular progression,

$$\left[x_n = \xi^{(n^0)} \eta^{\pm (n^1)} \zeta^{(n^2)} \right]$$

between the star and the Sun's surface, nine of which will be extra planetary, nine will be in simple planetary relations, and nine will be intra-planetary.

The upper extra-planetary abscissa bears nearly the same ratio to the modulus of light, as L bears to solar radius.

The limiting abscissas of the planetary series are determined by combining diametral centres of oscillation ($2\times\frac{2}{3}$), with centres of explosive condensation ($\frac{8}{9}$), and of explosive oscillation ($\frac{5}{9}$).

The planetary series, between these limits, is $\frac{1}{2}$ ♀, $\frac{2}{3}$ ⊕, $\frac{3}{4}$ ♂, $\frac{4}{5}$ mean asteroid, $\frac{5}{6}$ ♃, $\frac{6}{7}$ ♄, $\frac{7}{8}$ ♅.

* Mean centre of gravity of ☿ and ⊕ at heliocentric conjunction.

† Mean centre of gravity of all the planets, at heliocentric conjunction.

The co-efficient of the inner limiting planetary abscissa ($\frac{4}{3} \times \frac{5}{9}$ ☿) is nearly equivalent to the co-efficient of the exterior intra-asteroidal abscissa ($\frac{3}{4}$ ♄).

The co-efficient of the outer planetary abscissa ($\frac{4}{3} \times \frac{8}{9}$ ♆) is nearly the reciprocal of the co-efficient of the inner extra-asteroidal abscissa ($\frac{5}{6}$ ♃).

The middle abscissa of the planetary series corresponds very nearly with the inner limit of the asteroidal belt (Flora = 2.674854), as well as with $\frac{4}{5}$ of the mean distance of the three principal central asteroids (2.672519), and with $\frac{4}{5}$ of the geometrical mean between Flora and Cybele (2.683640).

Between modulus and the influent centre of solar explosive oscillation ($\frac{4}{9}$ L) there are fifteen abscissas, of which $\frac{6}{7}$ ♄ is the middle one.

Between the Saturnian abscissa and $\frac{7}{9}r$, there are fifteen abscissas, of which $\frac{4}{9}$ L is the middle one.

The abscissas representing centres of effluent or influent explosive condensation ($\frac{8}{9}$ M and $\frac{1}{9}$ L), are similarly situated with reference to the intermediate planetary belt.

No probable values can be assigned to the cardinal abscissas (α Centauri and $\frac{4}{9}$ L), which will produce deviations of the theoretical from the observed values of a higher order of magnitude than the planetary eccentricities.

Henderson's first estimate of the parallax of α Centauri was 1″.16. Maclear's observations, in 1839–40, gave ″.9128, and his more extended series, 1839–48, gave ″.9187. Norton adopts ″.913; Lockyer, ″.9187; Denison, without assigning any reason, ″.976. We may reasonably regard Norton's and Denison's estimates as the limits of probable value, and compute the logarithmic η and ζ from each estimate by the following equations.

$$\xi + 20\,\eta + 400\,\zeta = 7.686009 \text{ (N), or } 7.657096 \text{ (D)}$$
$$\xi = \tfrac{4}{9}\,\text{L} = 1.208919.$$
$$\xi - \nu\,\eta + \nu^2\,\zeta = -1.221849$$
$$\eta = 2\,\nu\,\zeta$$

Solving these equations we obtain:

$$\eta = .211401 +, \text{ or } .210702 +$$
$$\zeta = .005622 +, \text{ or } .005585 +$$

In the following table, C′ contains the abscissas according to Norton; C″, according to Denison; C‴, according to the actual planetary mean distances. The degree of accordance, between the parabolas which are computed from stellar and solar data and the one which is computed from planetary data, and the evidences of æthereal condensation which are furnished by the gradual lengthening of the observed abscissas, are especially noteworthy.

(V.)

	C′	C″	C‴	O
α Cent.	7.686009	7.657096	7.654826	
L×M	7.255323	7.228566	7.218310	7.215776
	6.835882	6.811207	6.801940	
	6.427687	6.405019	6.396716	
	6.030738	6.010001	6.002638	
$\frac{8}{9}$ M	5.645034	5.626153	5.619706	5.627715
	5.270576	5.273476	5.247920	
	4.907363	4.891970	4.887280	
	4.555395	4.541654	4.537786	
	4.214673	4.202470	4.199438	
$\frac{4}{3}\times\frac{8}{9}$ ♆	3.885196	3.874475	3.872236	3.883597
$\frac{7}{8}$ ♅	3.566964	3.557651	3.556180	3.557071
$\frac{6}{7}$ ♄	3.259978	3.251999	3.251270	3.244704
$\frac{5}{6}$ ♃	2.964237	2.957515	2.957506	2.969211
$\frac{4}{5}$ *	2.679741	2.674204	2.674888	2,672519
$\frac{3}{4}$ ♂	2.406491	2.402063	2.403416	2.389060
$\frac{2}{3}$ ⊕	2.144486	2.141093	2.143090	2.156064
$\frac{1}{2}$ ♀	1.893726	1.891294	1.893910	1.890463
$\frac{4}{3}\times\frac{5}{9}$ ☿	1.654212	1.652665	1.655876	1.643972
	1.425943	1.425207	1.428988	
$\frac{4}{9}$ L	1.208919	1.208919	1.213246	1.208919
	1.003140	1.003802	1.008650	
	.808607	.809856	.815200	
$\frac{1}{9}$ L	.625319	.627081	.632896	.606858
	.453276	.455477	.461738	
	.292479	.295042	.301726	
	.142927	.145779	.152860	
	.004620	.007686	.015140	
$\frac{7}{9}$	–1.877559	–1.880764	–1.888566	–1.890856
	–1.761743	–1.765013	–1.773138	
	–1.657172	–1.660432	–1.668856	
	–1.563847	–1.567023	–1.575720	
	–1.481767	–1.484783	–1.493730	
	–1.410932	–1.413714	–1.422886	
	–1.351343	–1.353816	–1.363188	
$\frac{1}{5}$	–1.303000	–1.305089	–1.314636	–1.301030
	–1.265902	–1.267532	–1.277230	
	–1.240049	–1.241146	–1.250970	
	–1.225441	–1.225931	–1.235856	
	–1.222078	–1.221886	–1.231888	
	–1.229961, &c.	–1.229011, &c.	–1.239066, &c.	